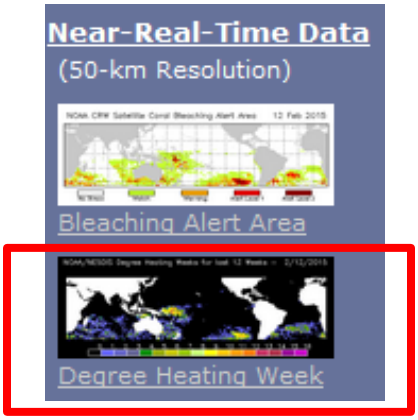
The goal of these hands-on exercises is to reinforce the concepts taught in the online tutorial, using simple examples, and to familiarize users with our website so they will know where to find each of the products. For each exercise, please follow along, starting from the main page of the NOAA Coral Reef Watch (CRW) website: http://coralreefwatch.noaa.gov/satellite/.

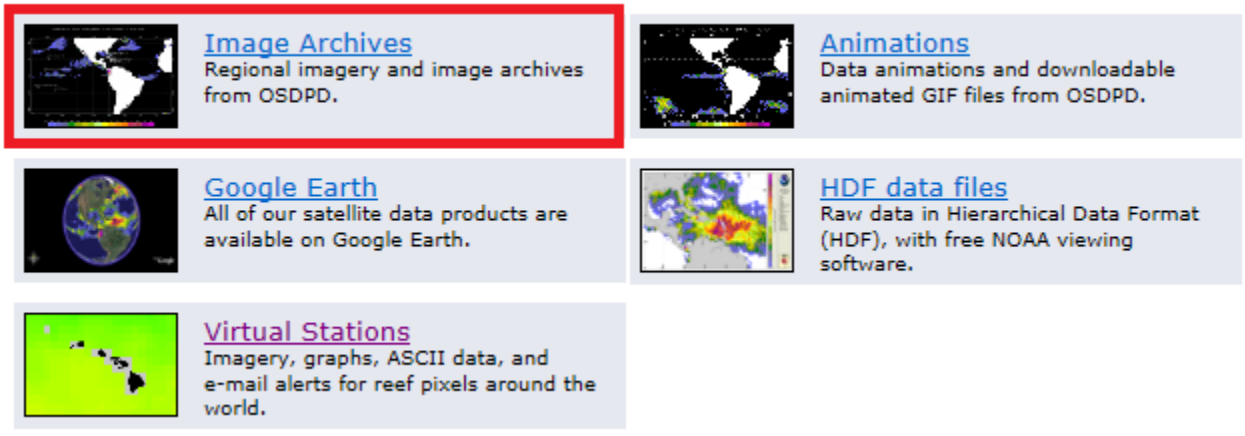
Degree Heating Week (DHW) product exercises

7. Using the Pacific Ocean's Degree Heating Week (DHW) image from September 20, 2002, was there bleaching in Hawaii? Compare the stress in the main Hawaiian Islands to the Northwestern Hawaiian Islands. What pattern of bleaching would you expect?

a. Return to CRW's 50-km homepage. Click on **Degree Heating Week** in the left-hand navigation bar.

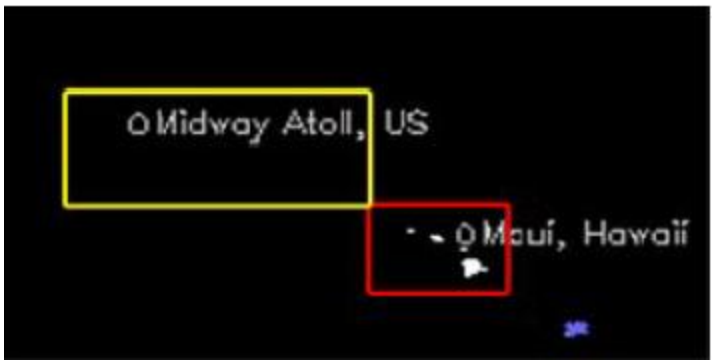


b. Click on **Image Archives**, and scroll to the bottom of the page. Click on "2002 Degree Heating Weeks".

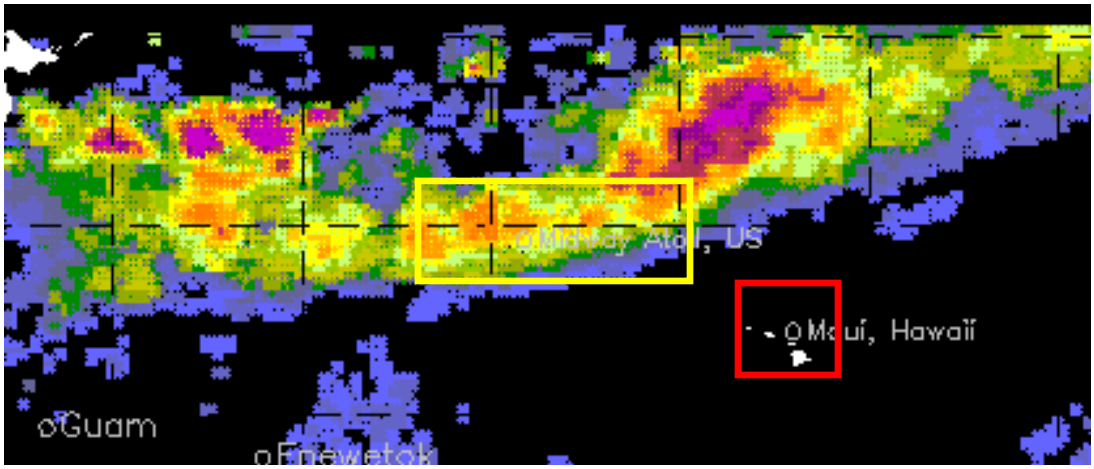


c. Scroll down the page to find September 20, 2002 for the **Pacific** region; click on it.

d. To locate Hawaii, look for the two Virtual Stations in this archipelago: Maui and Midway. In the image below, the red box shows the main Hawaiian Islands and the yellow shows the Northwestern Hawaiian Islands.



e. Now look at the DHWs in those areas for September 20, 2002. Was there bleaching? Compare the Northwestern Hawaiian Islands to the main Hawaiian Islands. What pattern of bleaching severity would you expect? (*#7 on the answer sheet*)

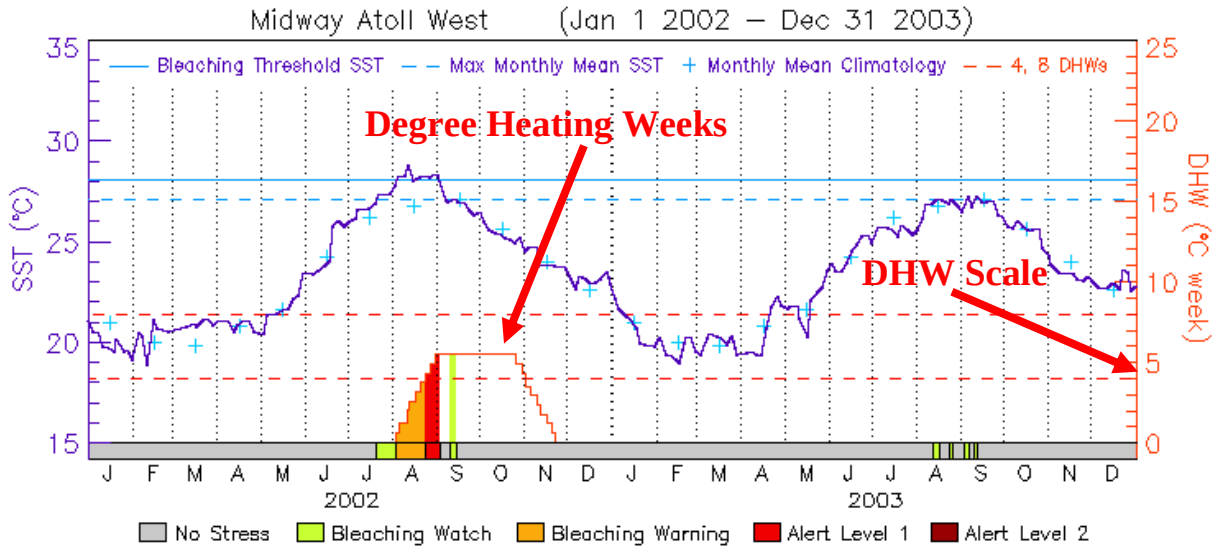


8. Now we will look at this 2002 Northwestern Hawaiian Islands thermal stress event in more detail by focusing on the Midway Atoll North Virtual Station. When did thermal stress start and end? Over what time do you think significant bleaching occurred?

a. Return to CRW's 50-km homepage. Click on **Virtual Stations** in the left-hand navigation bar. Click on "All 50-km stations and products".

b. From the table of CRW's operational 50-km Virtual Stations, find and click on **Midway Atoll North**.

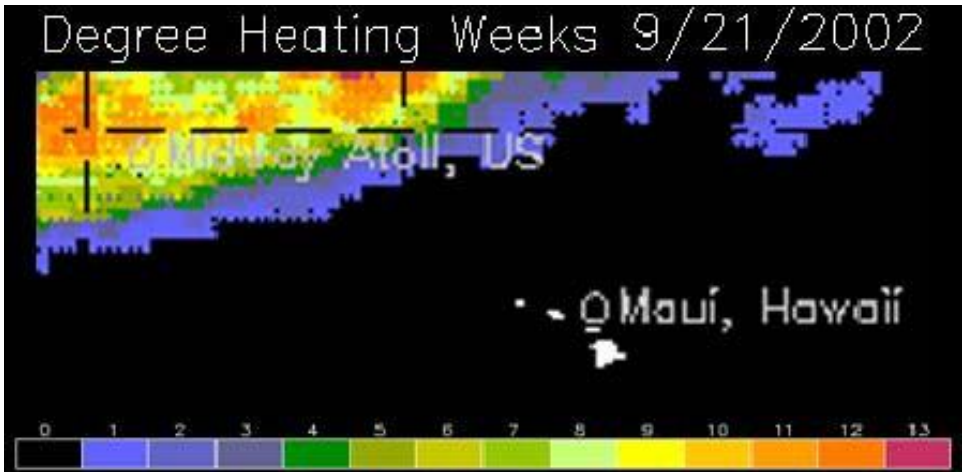
c. You will now see the time series data at this Virtual Station. SST and monthly means are shown at the top of the graph; Degree Heating Weeks are shown as a separate trace in the bottom section of each graph. Note that the DHW scale is on the right axis, as in the example image below from Midway Atoll West:



d. Use the 2002 Midway Atoll North graph to answer these questions:
    1. When did the bleaching thermal stress start and end? (In other words, when did the DHWs begin to accumulate, and when did the SST drop below the bleaching threshold?) (*#8 on the answer sheet*)
    2. Over what time do you think significant bleaching occurred? (HINT: a text file of these data is also available, if you want more precision in your answer. Go back one page to the Virtual Stations table, and click on the link for **data** under Midway Atoll North.) (*#8 on the answer sheet*)

DEGREE HEATING WEEK (DHW) PRODUCT ANSWER SHEET

7. The Degree Heating Weeks (DHWs) were highest at the northern end of the Northwestern Hawaiian Island chain, reaching a maximum of around 11 or 12 °C-weeks near Midway Atoll. Values then decrease sharply as you move south and east, and disappear altogether before you're halfway to the main Hawaiian Islands. In areas around Midway where the DHWs were above 8 °C-weeks, you would expect widespread bleaching and some coral mortality. South and east of there, a zone where DHWs were between 4 and 8 °C-weeks should have seen significant bleaching, especially in sensitive coral species. Areas in the blue range of the color bar, at less than 4 °C-weeks, may have experienced mild bleaching. NOAA monitoring cruises surveyed for bleaching just after this 2002 thermal stress event. They reported the first severe mass bleaching in the Northwestern Hawaiian Islands, with a gradient of bleaching that was highest in the far northwest (Kenyon et al., 2006).



8. By looking at the graph and at the text data file, we can see when the temperature first crossed the bleaching threshold: July 30, 2002. In the data file, you can determine this date because it's the day when DHWs are greater than zero and the HotSpot also goes above one. On the graph, you can see when the SST trace crosses the bleaching threshold (solid light-blue line). The thermal stress ended on September 7, 2002. In the data file, you can see when this happens because the HotSpot goes back below one and the DHWs are no longer increasing. On the graph, you can look for the date when the SST crosses back below the bleaching threshold. You expect to see significant bleaching when DHWs are greater than 4 °C-weeks. At the Midway Atoll North Virtual Station, DHWs remained above 4 °C-weeks from August 16 through November 4, so we can expect that bleaching occurred during that time period.